

Claims

- [c1] A system for manipulating articles generally traveling in a direction of conveyance comprising:
- a bed comprising a plurality of conveyor groups, each said conveyor group being generally aligned with each other in the direction of conveyance and each said conveyor group comprising a plurality of individual conveyors positioned side-by-side in a direction transverse to the direction of conveyance, said conveyors adapted to at least partially support articles traveling thereon and to move the articles in the direction of conveyance;
 - at least one sensor adapted to determine the position of the articles traveling over said plurality of conveyor groups; and
 - a controller in communication with said at least one sensor and said conveyors, said controller adapted to manipulate articles traveling on said bed by controlling the speed of said conveyors, said controller further adapted to rotate an article positioned on said bed by controlling the speed of selected ones of the conveyors underneath the article such that at least a first one of said selected ones of said conveyors has a different speed than a second one of said selected conveyors.

- [c2] The system of claim 1 wherein said controller is further adapted to cause at least one other article on said bed to move in the direction of conveyance while an article is being rotated on said bed.
- [c3] The system of claim 1 wherein said controller is adapted to rotate an article generally about a center of the article.
- [c4] The system of claim 1 wherein the speed of said selected ones of said conveyors is set generally as a function of a distance of said selected ones of said conveyor to a point on the article.
- [c5] The system of claim 4 wherein said point on the article is an intended point of rotation of the article.
- [c6] The system of claim 4 wherein said point on the article is substantially at a center of gravity of the article.
- [c7] The system of claim 1 further including a flow-splitter positioned adjacent to a downstream end of said bed, said flow-splitter adapted to steer articles exiting said bed to one of a plurality of downstream conveyors.
- [c8] The system of claim 7 wherein said flow-splitter comprises a plurality of powered, steerable wheels that define a conveying surface.

- [c9] The system of claim 1 wherein said controller is further adapted to determine if two articles having overlapping alignment in a transverse direction on said bed are on opposite sides of a dividing line extending in the direction of conveyance, said transverse direction extending in a direction transverse to the direction of conveyance, said controller adapted to cause said two articles to exit said bed during at least one coincident moment in time if said two articles are on opposite sides of said dividing line.
- [c10] The system of claim 9 wherein said dividing line is positioned in a center of said bed.
- [c11] The system of claim 1 wherein said controller is further adapted to determine if two articles on said bed meet the conditions of:
- (i) said two articles having overlapping alignment in a direction transverse to the direction of conveyance and being on opposite sides of a dividing line extending in the direction of conveyance; or
 - (ii) one or both of said two articles can be rotated before exiting said bed such that said two articles will have overlapping transverse alignment on opposite sides of said dividing line after rotation;
- said controller adapted to cause said two articles to exit during at least one coincident moment in time if either

of conditions (i) or (ii) are met.

- [c12] The system of claim 11 wherein said dividing line is positioned generally at a center of said bed.
- [c13] The system of claim 1 wherein said conveyors are belt conveyors.
- [c14] The system of claim 1 wherein said at least one sensor comprises at least one video camera positioned above said bed.
- [c15] The system of claim 1 wherein said at least one sensor includes at least one array of photo-sensors oriented to emit and detect signals traveling generally in a vertical direction, said signals being obstructed by articles traveling past said array.
- [c16] The system of claim 1 further including a gapping mechanism positioned upstream of said bed, said gapping mechanism adapted to move articles traveling thereon further apart in a direction transverse to the direction of conveyance.
- [c17] The system of claim 16 further including a transition belt positioned adjacent a downstream end of said gapping mechanism, said transition belt operating at a speed such that articles traveling from said gapping mecha-

nism to said transition belt are moved further apart in a direction parallel to the direction of conveyance.

[c18] The system of claim 1 further including a transition belt upstream of said bed, said transition belt substantially continuously feeding said bed articles to be manipulated.

[c19] The system of claim 1 wherein said controller is adapted to separate a batch of articles.

[c20] The system of claim 1 wherein said controller is adapted to singulate articles.

[c21] A method of manipulating articles, comprising:
providing a bed having at least one conveying surface adapted to move articles in a direction of conveyance from an upstream end to a downstream end of said bed;
providing at least one sensor and using said at least one sensor to determine the position of any articles on said bed during at least one moment in time;
selecting an article on said bed to be manipulated;
determining whether said selected article is to be rotated;
moving said selected article in the direction of conveyance at a speed generally higher than articles traveling on said bed that have yet to be manipulated; and
if said article is to be rotated, rotating the selected arti-

cle.

- [c22] The method of claim 21 wherein said rotating said selected article includes simultaneously moving at least an upstream portion of said conveying surface such that one or more articles can be received at an upstream end of said bed while said article is being rotated.
- [c23] The method of claim 21 wherein said bed comprises a plurality of conveyor groups, each said conveyor group being generally aligned with each other in the direction of conveyance and each said conveyor group comprising a plurality of individual conveyors positioned side-by-side in a direction transverse to the direction of conveyance.
- [c24] The method of claim 23 wherein said individual conveyors are belt conveyors.
- [c25] The method of claim 21 further comprising substantially continuously feeding articles to said bed.
- [c26] The method of claim 25 further comprising manipulating articles.
- [c27] The method of claim 21 further comprising feeding articles to said bed in a batch.
- [c28] The method of claim 27 further comprising separating

articles from a batch.

[c29] The method of claim 21 comprising rotating the selected article generally about a center of the article.

[c30] The method of claim 21 further comprising determining if two articles having overlapping alignment in a transverse direction on said bed are on opposite sides of a dividing line extending in the direction of conveyance, said transverse direction extending in a direction transverse to the direction of conveyance; and moving said conveying surface such that said two articles exit said bed during at least one coincident moment in time if said two articles are on opposite sides of said dividing line.

[c31] The method of claim 21 further comprising determining if two articles on said bed meet the conditions of:
(i) said two articles having overlapping alignment in a direction transverse to the direction of conveyance and being on opposite sides of a dividing line extending in the direction of conveyance; or
(ii) one or both of said two articles can be rotated before exiting said bed such that said two articles will have overlapping transverse alignment and be on opposite sides of said dividing line after rotation; and moving said conveying surface such that the two articles

exit said bed during at least one coincident moment in time if either of conditions (i) or (ii) are met.

[c32] The method of claim 21 wherein said at least one conveying surface is made up of a plurality of conveyors and wherein said rotating the selected article comprises controlling the speed of selected ones of said conveyors such that at least a first one of said selected ones of said conveyors has a different speed than a second one of said selected conveyors.

[c33] A system for manipulating articles generally traveling in a direction of conveyance comprising:
a bed having at least one conveying surface adapted to move articles in a direction of conveyance from an upstream end to a downstream end of said bed;
at least one sensor adapted to determine the position of the articles traveling on said bed; and
a controller in communication with said at least one sensor and said bed, said controller adapted to manipulate articles traveling on said bed by controlling the speed of said conveying surface, said controller further adapted to determine if two articles having overlapping alignment in a transverse direction on said bed are on opposite sides of a dividing line extending in the direction of conveyance, said transverse direction extending in a direction transverse to the direction of conveyance, said con-

troller adapted to cause the two articles to exit a downstream end of said bed during at least one coincident moment in time if the two articles are on opposite sides of said dividing line.

- [c34] The system of claim 33 wherein said dividing line is positioned in a center of said bed.
- [c35] The system of claim 33 said bed comprises a plurality of conveyor groups, each said conveyor group being generally aligned with each other in the direction of conveyance and each said conveyor group comprising a plurality of individual conveyors positioned side-by-side in a direction transverse to the direction of conveyance.
- [c36] The system of claim 35 wherein said individual conveyors are belt conveyors.
- [c37] The system of claim 33 wherein said at least one sensor comprises at least one video camera positioned above said bed.
- [c38] The system of claim 33 further including a gapping mechanism positioned upstream of said bed, said gapping mechanism adapted to move articles traveling thereon further apart in a direction transverse to the direction of conveyance.

[c39] The system of claim 38 further including a transition belt positioned adjacent a downstream end of said gapping mechanism, said transition belt operating at a speed such that articles traveling from said gapping mechanism to said transition belt are moved further apart in a direction parallel to the direction of conveyance.

[c40] The system of claim 33 wherein said at least one sensor includes at least one array of photo-sensors oriented to emit and detect signals traveling generally in a vertical direction, said signals being obstructed by articles traveling past said array.

[c41] The system of claim 33 wherein said controller is further adapted to:

- (i) determine if one or both of said two articles can be rotated before exiting said bed such that said two articles will have overlapping transverse alignment and be on opposite sides of said dividing line after rotation; and
- (ii) cause said conveying surface to move such that the two articles exit said bed during at least one coincident moment in time if condition (i) is met.

[c42] The system of claim 33 wherein said controller is further adapted to be able to rotate an article positioned on said bed by controlling the speed of selected portions of the conveying surface underneath the article such that dif-

ferent portions of the conveying surface underneath the article have different speeds.

- [c43] The system of claim 42 wherein said controller is further adapted to cause at least one other article on said bed to move in the direction of conveyance while an article is being rotated.
- [c44] The system of claim 33 further including a transition belt upstream of said bed, said transition belt substantially continuously feeding said bed articles to be manipulated.
- [c45] A method of manipulating articles, comprising:
 - providing a bed having at least one conveying surface adapted to move articles in a direction of conveyance from an upstream end to a downstream end of said bed;
 - providing at least one sensor and using said sensor to determine the position of any articles on said bed during at least one moment in time;
 - determining whether two articles on said bed have overlapping alignment in a transverse direction and whether said two articles are on opposite sides of a dividing line, said transverse direction extending in a direction transverse to the direction of conveyance, and said dividing line extending in the direction of conveyance; and
 - if said two articles are on opposite sides of said dividing line and have overlapping transverse alignment, moving

the two articles such that they exit a downstream end of said bed during at least one coincident moment in time.

[c46] The method of claim 45 wherein said dividing line is positioned in a center of said bed.

[c47] The method of claim 45 wherein said bed comprises a plurality of conveyor groups, each said conveyor group being generally aligned with each other in the direction of conveyance and each said conveyor group comprising a plurality of individual conveyors positioned side-by-side in a direction transverse to the direction of conveyance.

[c48] The method of claim 47 wherein said individual conveyors are belt conveyors.

[c49] The method of claim 45 further comprising substantially continuously feeding articles to said bed to be manipulated.

[c50] The method of claim 45 further comprising:
(i) determining if one or both of said two articles can be rotated before exiting said bed such that said two articles will have overlapping transverse alignment and be on opposite sides of said dividing line after rotation; and
(ii) if condition (i) is met, rotating one or both of said articles and moving said conveying surface such that the

two articles exit said bed during at least one coincident moment in time.

[c51] The method of claim 45 further including spreading articles apart in a direction transverse to the direction of conveyance prior to said articles entering onto said bed.

[c52] A system for manipulating articles generally traveling in a direction of conveyance comprising:
a bed comprising a plurality of conveyor groups, said conveyor group being generally aligned with each other in the direction of conveyance and each said conveyor group comprising a plurality of individual conveyors positioned side-by-side in a direction transverse to the direction of conveyance, said conveyors adapted to at least partially support articles traveling thereon and to move the articles in the direction of conveyance;
at least one sensor adapted to determine the position of the articles traveling over said plurality of conveyor groups; and
a controller in communication with said at least one sensor and said conveyors, said controller adapted to manipulate articles traveling on said bed by controlling the speed of said conveyors, said controller further adapted to be able to control the speed of said conveyors at more than two different non-zero speeds.

[c53] The system of claim 52 further including a transition belt upstream of said bed, said transition belt substantially continuously feeding said bed articles to be manipulated.

[c54] The system of claim 52 wherein said controller is further adapted to be able to rotate an article positioned on said bed by controlling the speed of selected ones of the conveyors underneath the article such that at least a first one of said selected ones of said conveyors has a different speed than a second one of said selected conveyors.

[c55] The system of claim 52 wherein said controller is further adapted to determine if two articles having overlapping alignment in a transverse direction on said bed are on opposite sides of a dividing line extending in the direction of conveyance, said transverse direction extending in a direction transverse to the direction of conveyance, said controller adapted to cause said two articles to exit a downstream end of said bed during at least one coincident moment in time if said two articles are on opposite sides of said dividing line.

[c56] An article manipulation bed, comprising:
a plurality of conveyor groups, said conveyor groups being generally aligned with each other in a direction of conveyance and each of said conveyor groups comprising a plurality of conveyor units positioned side-by-side

in a direction transverse to the direction of conveyance;
each of said conveyor units comprising a first conveyor belt reeved at least partially around at least two first idler rollers, said first conveyor belt adapted to move articles carried thereon in a direction of conveyance;
each of said conveyor units further comprising a second conveyor belt reeved at least partially around at least two second idler rollers, said second conveyor belt adapted to move articles carried thereon in said direction of conveyance, said second conveyor belt being positioned alongside said first conveyor belt;
each of said conveyor units further comprising a first drive roller about which said first conveyor belt is at least partially reeved, said first drive roller rotatable about a first axis; and
each of said conveyor units further comprising a second drive roller about which said second conveyor belt is at least partially reeved, said second drive roller rotatable about a second axis;
wherein said first and second axes are not collinear with respect to each other in a direction transverse to the direction of conveyance.

[c57] The manipulation bed of claim 56 wherein said first drive roller is positioned forwardly, in said direction of conveyance, of said second drive roller.

[c58] The manipulation bed of claim 56 wherein each of said conveyor units further including a first motor attached to said first drive roller and a second motor attached to said second drive roller, said first motor extending toward said second conveyor belt in a direction transverse to the direction of conveyance, and said second motor extending toward said first conveyor belt in a direction transverse to the direction of conveyance.

[c59] The manipulation bed of claim 56 wherein said upstream endrollers of said first and second conveying belts are aligned with each other in a direction transverse to the direction of conveyance, and said downstream end rollers of said first and second conveying belts are aligned with each other in a direction transverse to the direction of conveyance.

[c60] The manipulation bed of claim 56 wherein each of said conveyor units further comprising a first tensioning roller in contact with said first conveyor belt and a second tensioning roller in contact with said second conveyor belt.

[c61] The manipulation bed of claim 60 wherein each of said conveyor units further comprising a first tensioning spring for biasing said first tensioning roller and a sec-

ond tensioning spring for biasing said second tensioning roller.

[c62] The manipulation bed of claim 56 wherein each of said conveying units further comprising a support plate between said first and second conveyor belts for supporting said first and second idler rollers and said first and second drive rollers.